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Advancing Satellite Networks & Combating Satellite Interference

Arabsat Operational Forum 2012

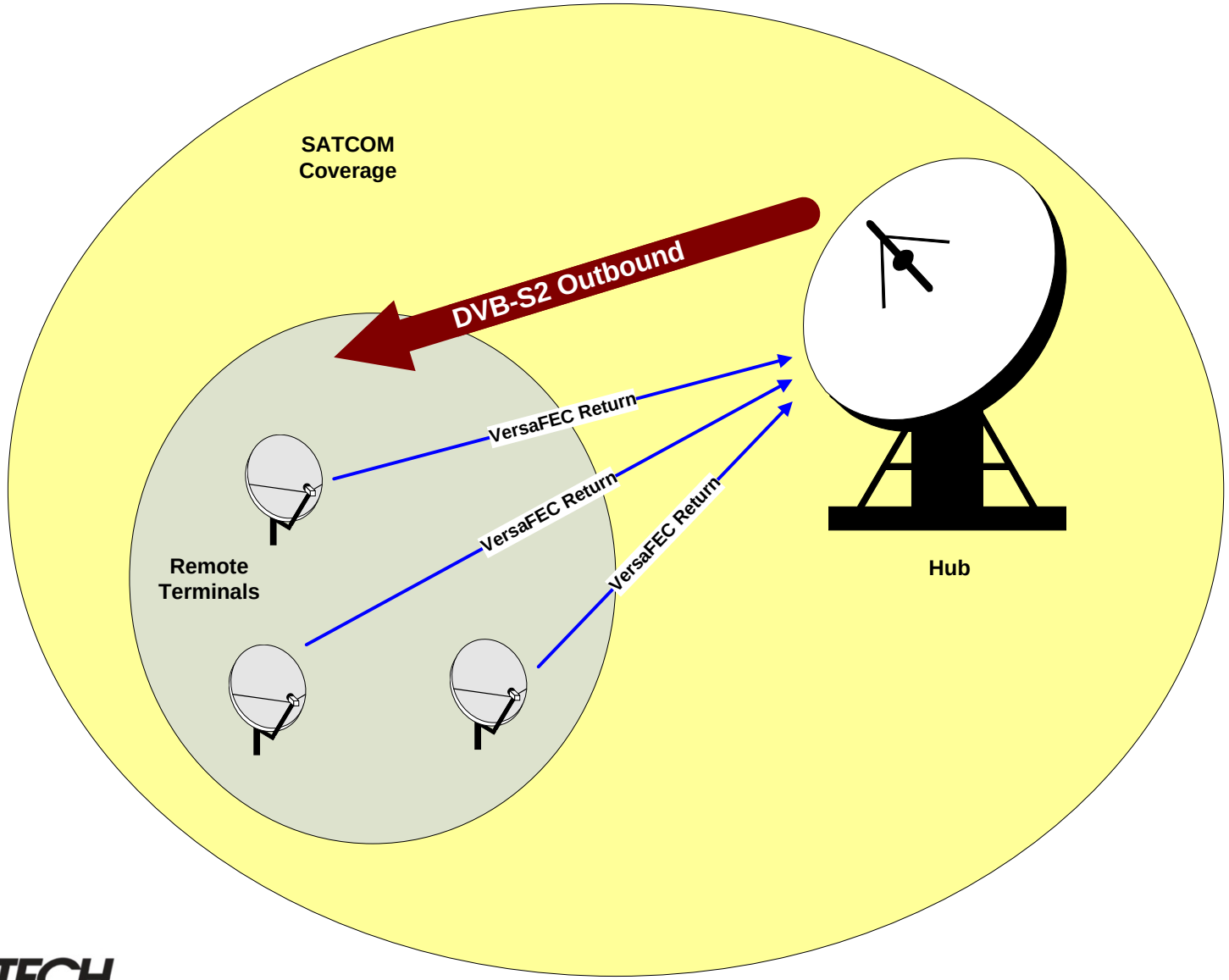
Paul Richardson, Regional VP Middle East

COMTECH EF DATA

Advancing Satellite Solutions

- Portfolio of managed network solutions to address
  - Mobile Backhaul
  - IP Trunking & Backhaul
  - Maritime & Offshore Connectivity
  - Corporate/Enterprise Networks
  - Emergency & Disaster Recovery

Network Topology



Hub Overview

Sub-System	Function
CDM-800 Gateway Router	Transmits high-speed DVB-S2 outbound
CDD-880 Multi-Receiver Router	Multi-receiver for VersaFEC return channel
CXU-810 RAN Optimizer	E1 aggregation and RAN optimization
Memotec CX-U 1240/1280	RAN optimization
CTOG-250 Traffic Optimization Gateway & Protocol Server	Advanced Quality of Service (QoS), Header & payload compression, ACM/VCM controller
Stampede FX-4000	WAN optimization & application acceleration
Network Management System	Network management
Vipersat dSCPC Controller	Dynamic bandwidth management
CRS-170A/180	Redundancy Switches

Remote Terminal

- Based on CDM-840 (or ODM-840 or ODMR-840)
- DVB-S2 outbound reception
- VersaFEC return channel transmission with ACM
- Packet processing and optimization including advanced QoS, header compression and lossless payload compression
- RAN optimization – integrated E1 RAN optimization
  - Memotec CX-U 1010/1220 can be used to support multiple E1s
- WAN optimization
  - Stampede FX-1000 can add WAN optimization and application acceleration

CDM-840 Remote Router

ODM-840 Remote Router

ODMR-840 Remote Router

High-Speed DVB-S2 Shared Outbound

- CDM-800 (Hub) to CDM-840 (Remote)
- Up to 160 Mbps / 62 Msps
- Automatic Coding and Modulation (ACM)
- Variable Coding & Modulation (VCM)
- Constant Coding & Modulation (CCM)
- Normal Frame, Short Frame
- Low overhead Enhanced Generic Stream Encapsulation
- Advanced Quality of Service (QoS)
  - Group QoS
    - DiffServ
    - Rule-based – CIR/MIR, Priority/MIR
- Header compression
- 2nd generation lossless payload compression

High Performance VersaFEC Return

- CDM-840 (Remote) to CDD-880 (Hub)
- VersaFEC low latency LDPC (Patented)
  - Up to 15.35 Mbps / 4.5 Msps
  - Adaptive Coding & Modulation (ACM)
  - Constant Coding & Modulation (CCM)
- Ultra low overhead Streamline Encapsulation (SLE) (Patent Pending)
- Advanced Quality of Service (QoS)
  - DiffServ
  - Rule-based – CIR/MIR, Priority/MIR
- Header compression
- 2nd generation lossless payload compression

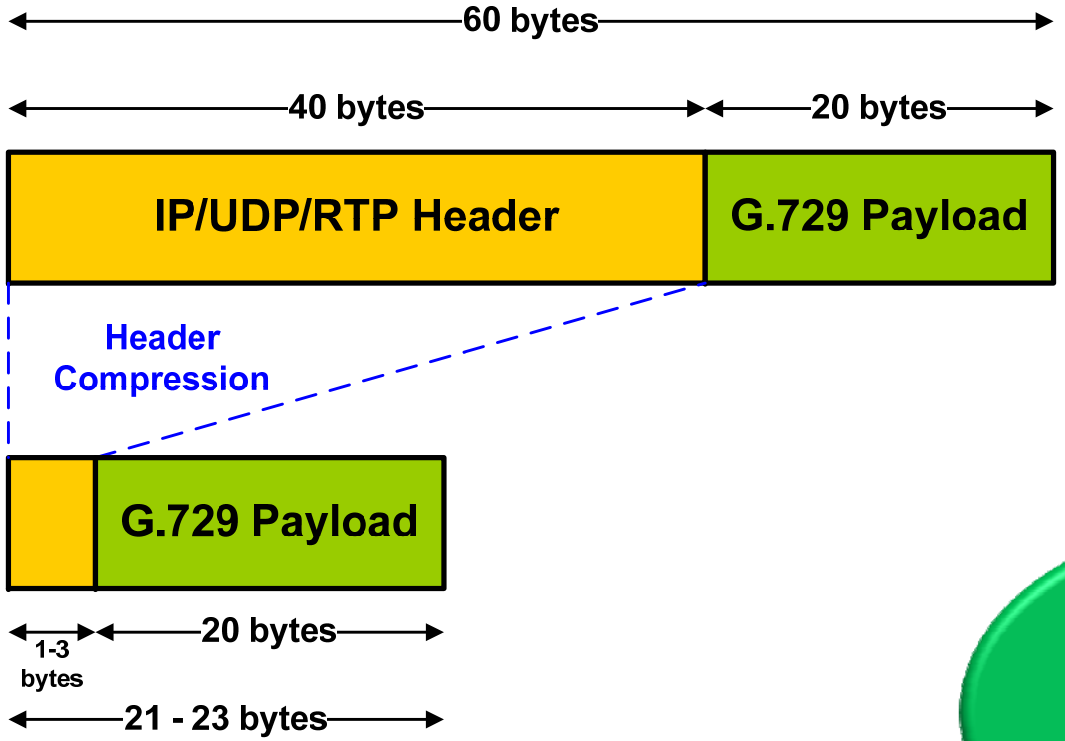
Return Channel ACM

- Based on VersaFEC ACM
- **Only product to support ACM with E1 RAN while maintaining service quality**
- ACM allows for automatic change in modulation and code rate in response to changing link conditions
  - Converts link margin into increased capacity
    - Most of the year, the link operates at significantly increased throughput
    - For the worst few hours of the year, the link may be available with lower throughput
  - Optimizes channel coding and modulation on a frame-by-frame basis
  - Allows each remote to operate optimally subject to antenna size, location within the footprint, rain fade and other impairments

Group QoS

- Group QoS enables multi-level QoS for the shared outbound
  - Provides additional flexibility and control to the network operator
- Group QoS is fully integrated with ACM / VCM
- Groups are defined by one or more IP address/ subnet
- Each group is assigned a CIR and MIR
- Within the group, QoS can be based on
  - DiffServ
  - Min/max
  - Max/priority
- Detailed stats are provided
- For VCM, MODCODs are assigned to each group

Header Compression



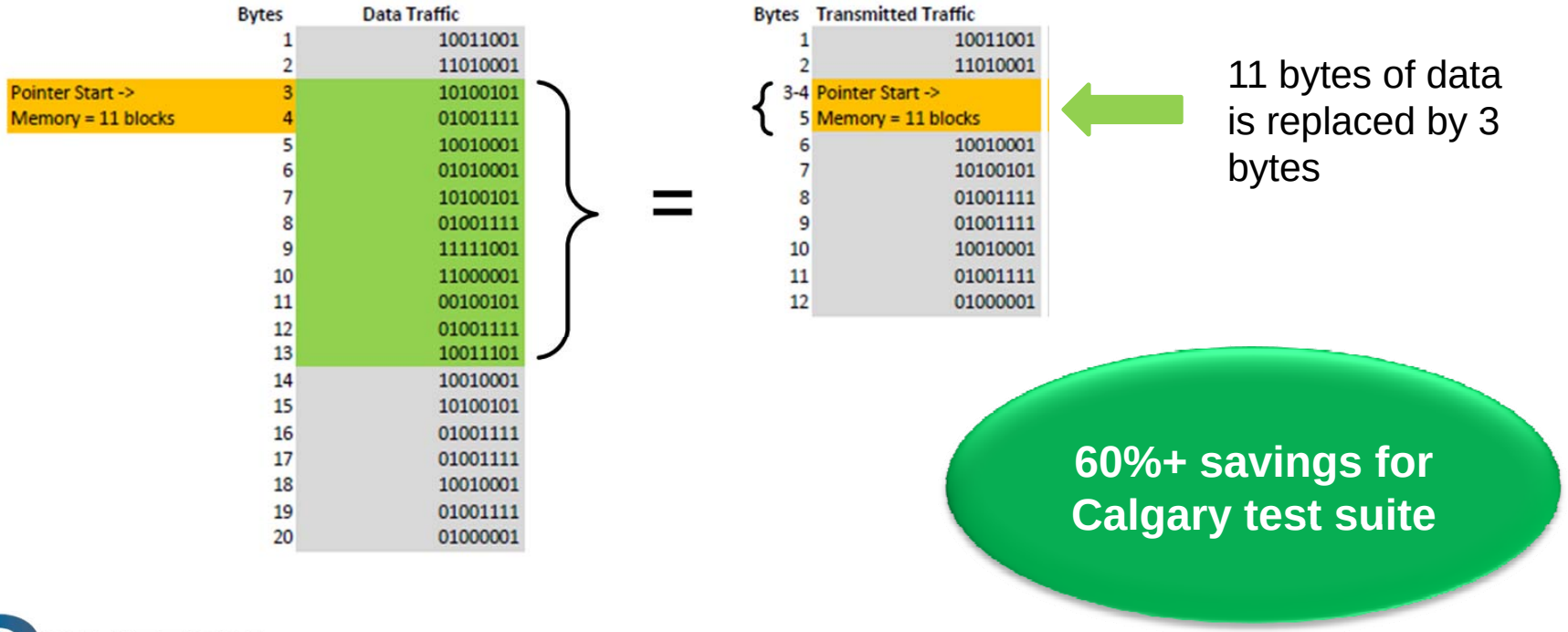
Layer 3 & 4 Header Compression

IP
TCP
UDP
RTP (Codec Independent)

60%+ Savings for Voice

Lossless Payload Compression
(2nd Generation)

- Most real world data has statistical redundancy
- Lossless data compression works by encoding source information using fewer bits
  - E.g. a repeating pattern is replaced with a pointer



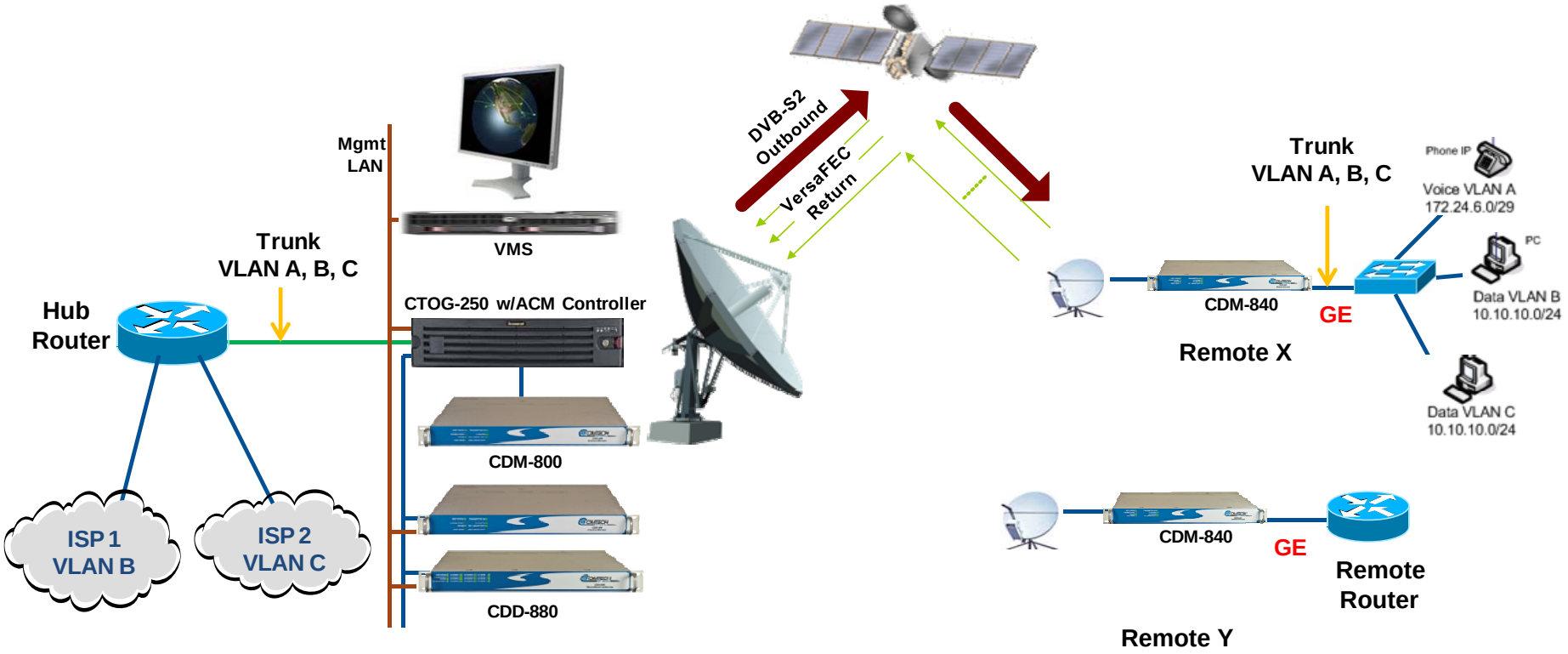
RAN Optimization

- RAN Optimization reduces the satellite bandwidth required for cellular backhaul
- Advanced VSAT Series provides maximum user control by allowing them to select the level of RAN optimization to achieve desired link quality and bandwidth savings
- Pre-emptive bandwidth management maintains superior voice and service quality even under WAN congestion
- Supporting E1 RAN and IP RAN, the Advanced VSAT Series for the first time provides a seamless migration from a legacy E1 RAN to an all IP RAN

E1 RAN Optimization

- CDM-840 supports integrated E1 RAN optimization
  - Abis Optimization
  - TDM compression
  - Support simultaneous E1 and Ethernet operation in Hub Spoke topology
  - Supports ACM with E1 RAN
- CXU-810 used at Hub
  - 16 x E1 version
  - 32 x E1 version
  - 63 x E1 version (TBD)
- Traffic trending
  - Ingress (E1 & LAN) and egress (WAN) traffic
  - Savings
  - Link quality

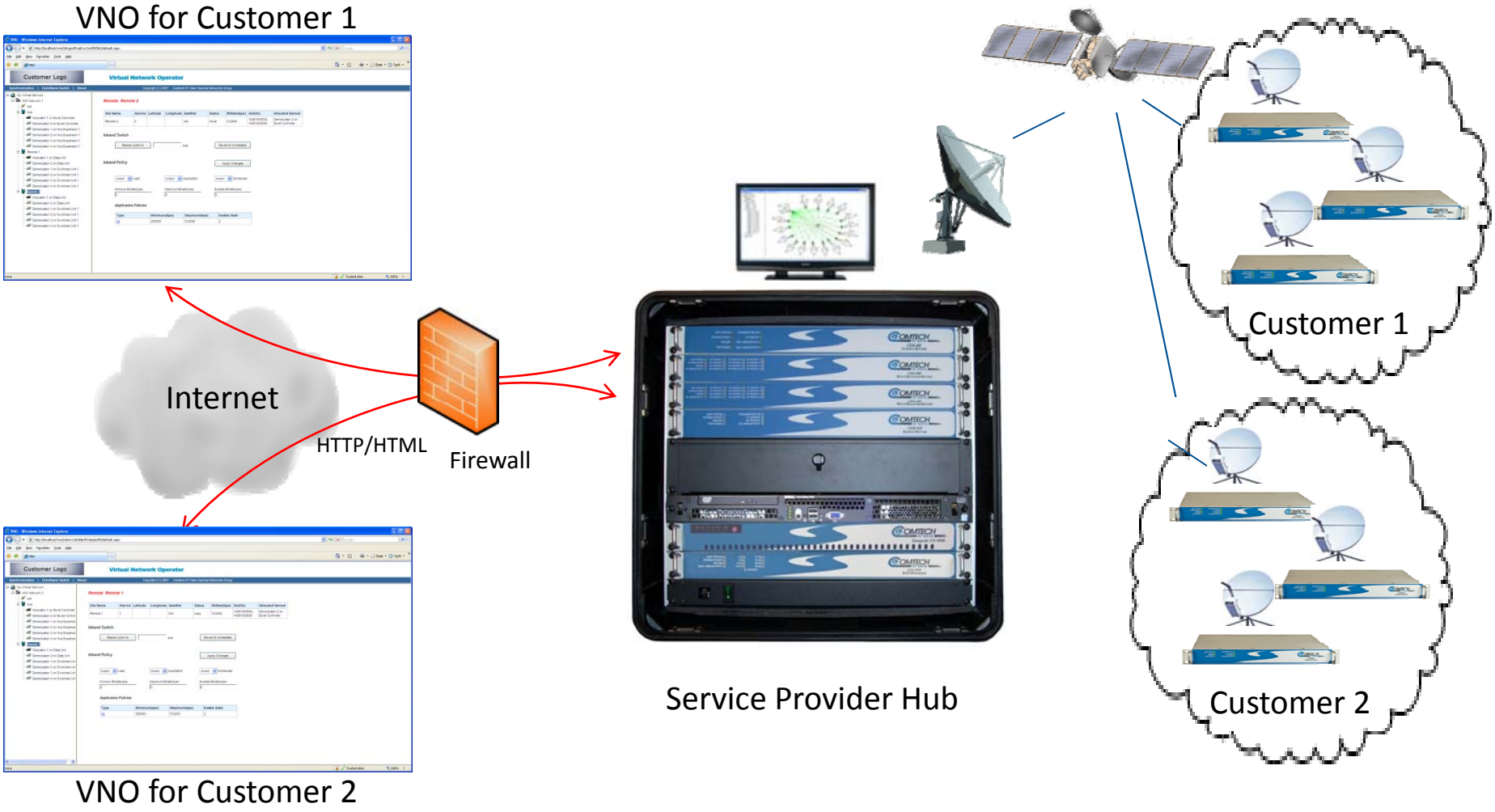
Layer 2 Operation w/VLAN



Vipersat NMS & dSCPC

- Dynamic bandwidth management
  - Bandwidth can be increased or decreased on demand
  - Lossless switching
- Switching Modes
  - Automatic Switching
    - Load Switching
      - Transmission buffer capacity fill level triggers BW request
    - Application Switching
      - Detection of specific application types triggers BW request
    - ToS Switching
      - Predefined DiffServ values triggers BW request
  - Manual Switching
    - Operator
    - Maintenance

Virtual Network Operator (VNO)



Value Proposition

- Efficiency
- Scalability
- Lower Total Cost of Ownership
- Better Quality
  - Guaranteed bandwidth
  - Real time traffic
    - Low latency
    - Low jitter
- Shelterless Installation

Bandwidth Efficiency

- DVB-S2 Outbound
  - Low Overhead Enhanced Generic Stream Encapsulation
  - Adaptive Coding & Modulation (ACM)
  - Variable Coding & Modulation (VCM)
- VersaFEC Return
  - Ultra Low Overhead Streamline Encapsulation (SLE)
  - Adaptive Coding & Modulation (ACM)
- Header Compression
  - IP/UDP/RTP, TCP/IP, IP/UDP etc
- 2nd Generation Lossless Payload Compression
- RAN Optimization
- WAN Optimization
- Vipersat dSCPC

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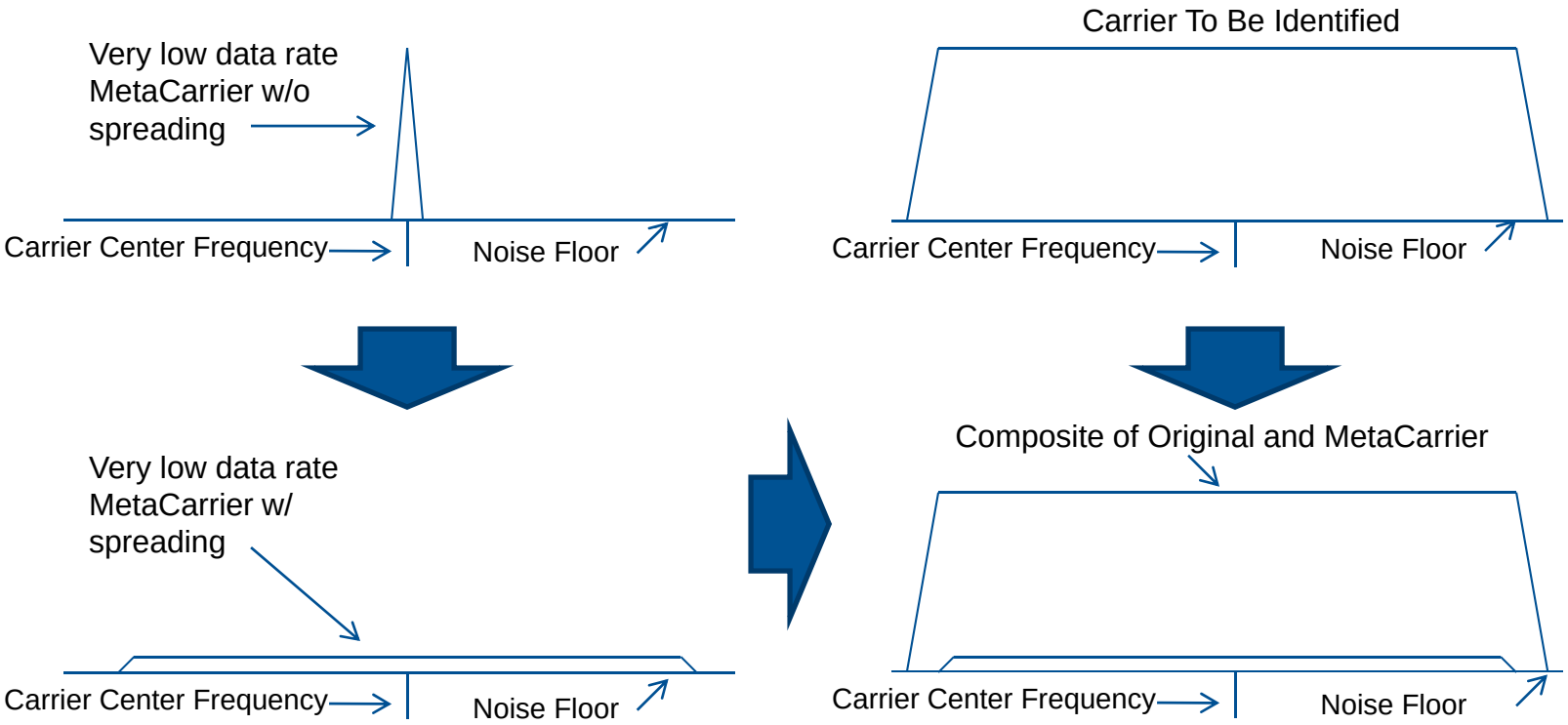
Value of Using Carrier ID

- Quick identification of an interfering carrier
  - A database will be created that contains the Carrier IDs, and would link it to the network operators contact information
  - The Space Data Association has agreed to maintain this, but any satellite operator could also maintain one
  - Compared to current methods, money and time are saved by this process
- The Carrier ID could be the MAC address of the modulator or CID embedder
  - For IP enabled devices a MAC address is unique, universal, and when transmitted, anonymous
- With the addition of Latitude/Longitude to the Carrier ID, the interferer can also be dealt with locally

Comtech EF Data
MetaCarrier™ Carrier ID

- MetaCarrier means that we have a separate carrier that contains information that is used to describe another single carrier
- What is unique is that the MetaCarrier is embedded using spread spectrum techniques within the carrier(s) or relay, without adding appreciable noise to the carrier(s) or relay
- It is completely waveform agnostic:
  - The:
    - Modulation type
    - FEC
    - Encryption
    - Etc.
  - Do not matter
- This version is for SCPC and video carriers

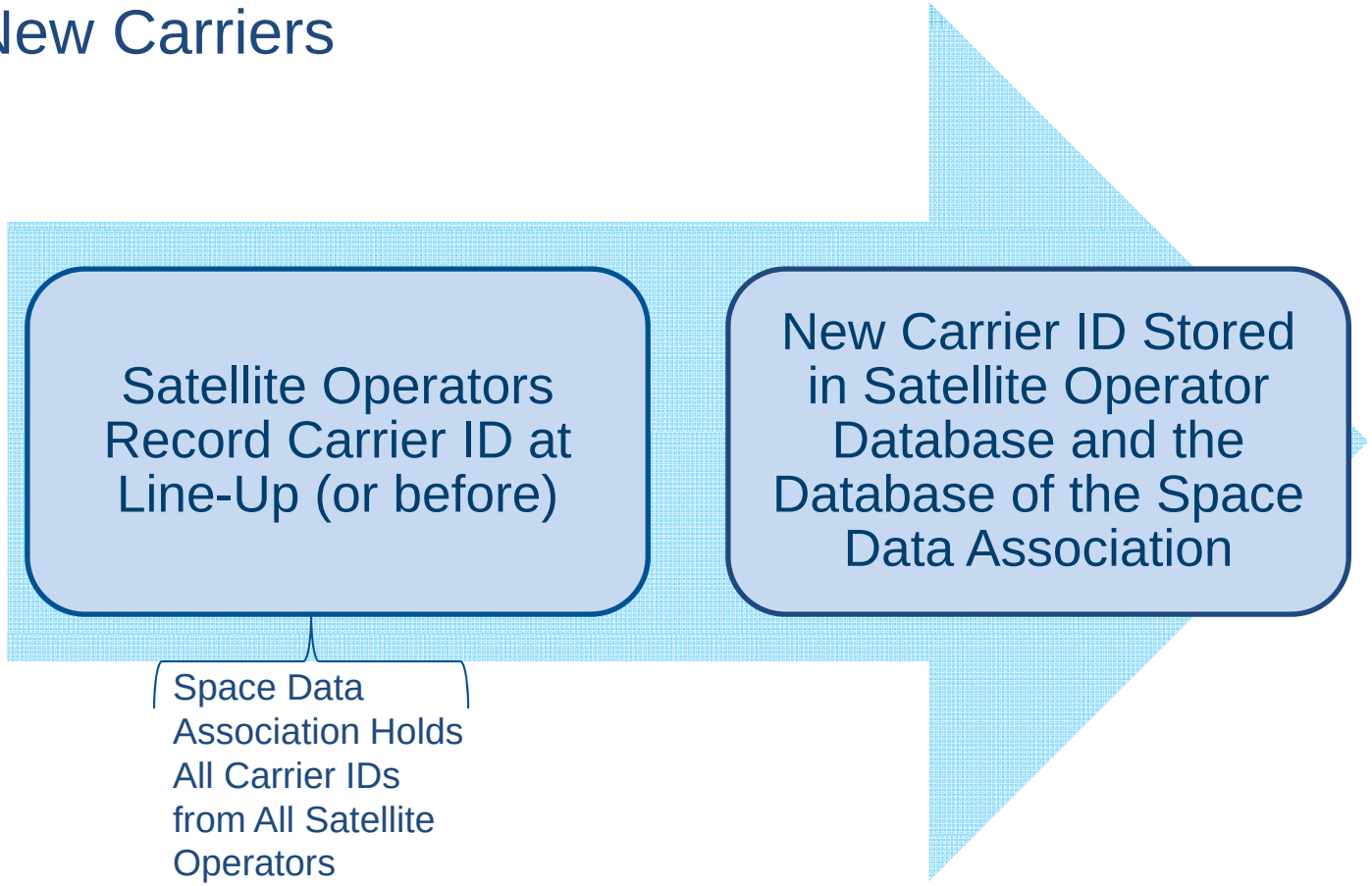
MetaCarrier Overlay



The MetaCarrier is placed 22 dB below the peak of the carrier it is identifying, at the center frequency of the carrier

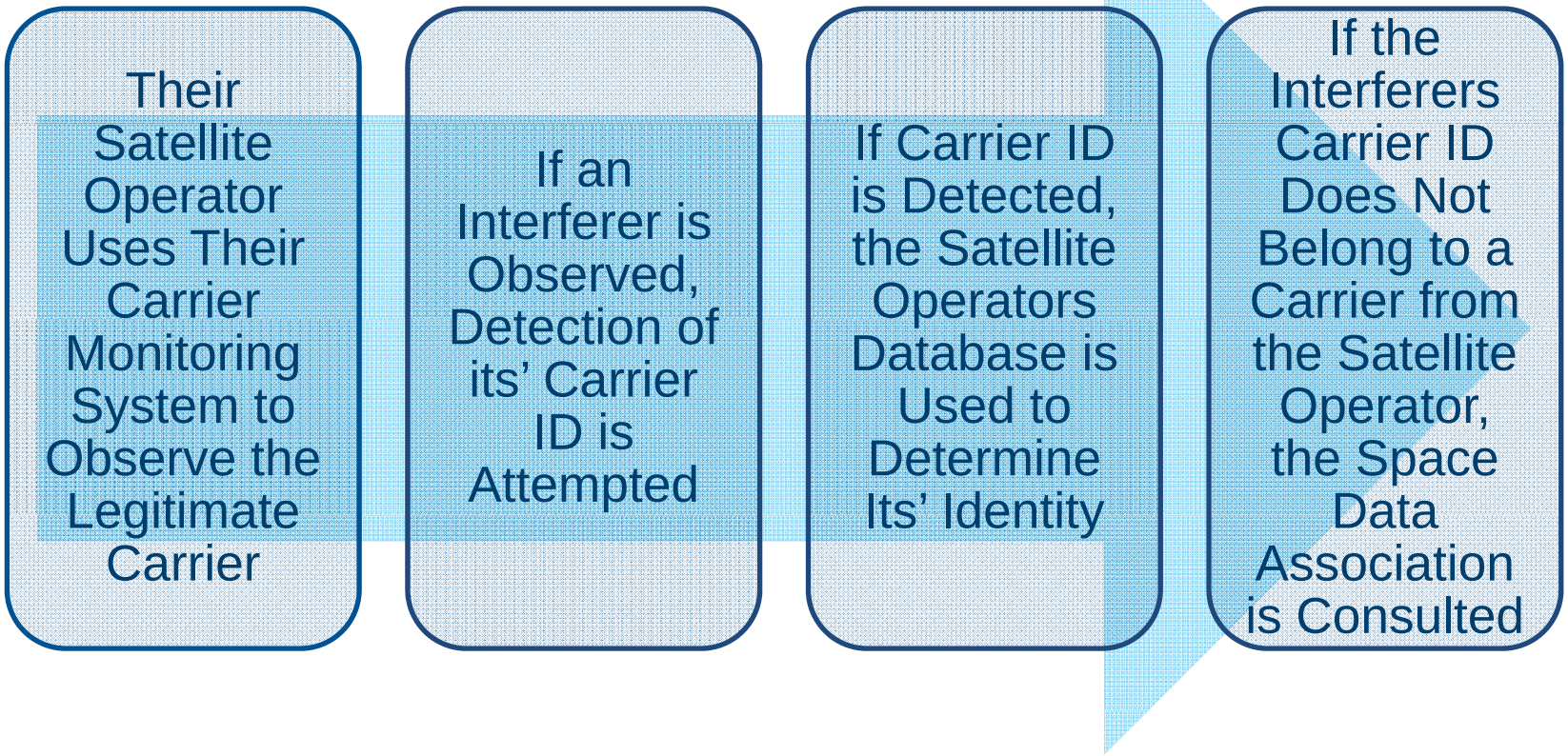
How Will Carrier ID Be Used?
Step #1 – Recording and Storage

Satellite Operators Call for Use of Carrier ID On All New Carriers


Satellite Operators Record Carrier ID at Line-Up (or before)
New Carrier ID Stored in Satellite Operator Database and the Database of the Space Data Association
Space Data Association Holds All Carrier IDs from All Satellite Operators

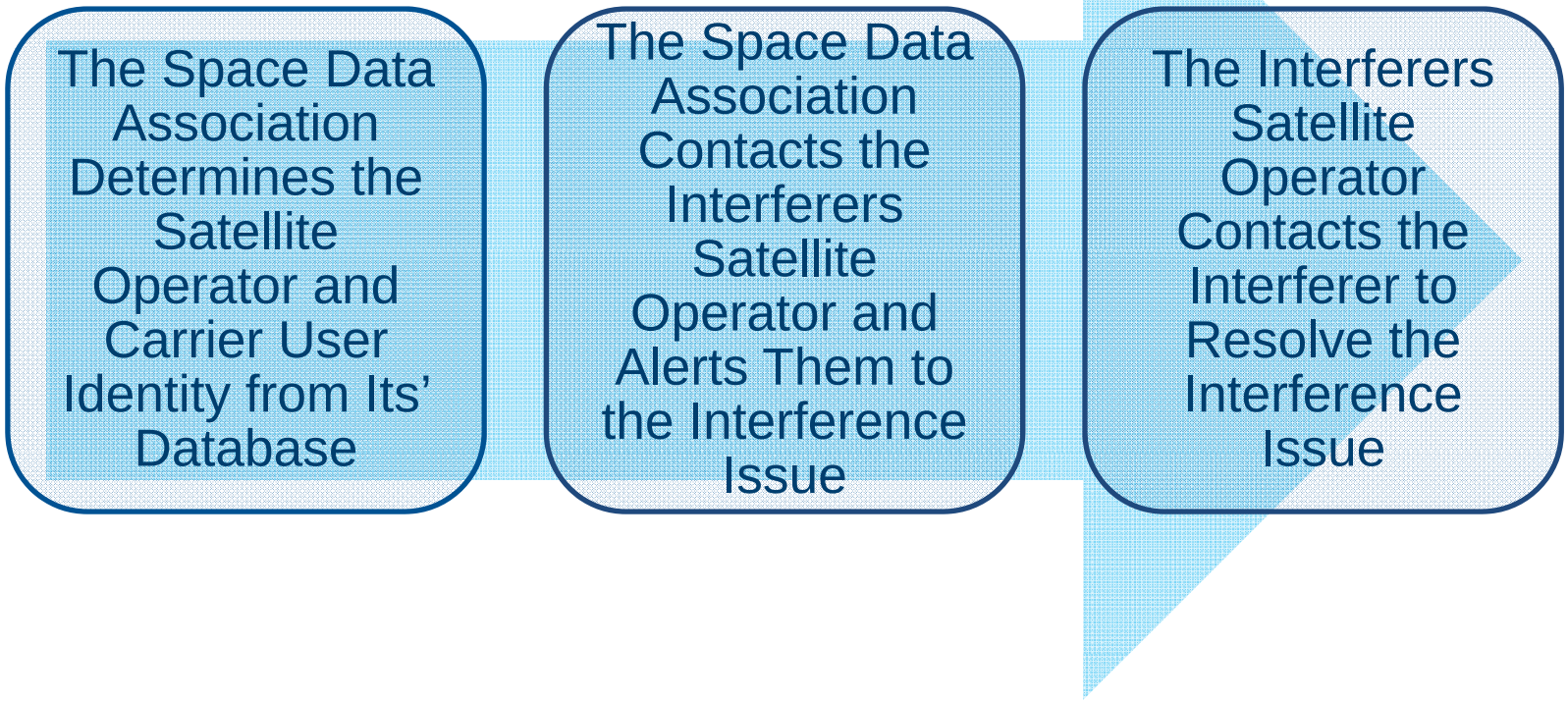
How Will Carrier ID Be Used?
Step #2 – During Interference Events

Situation; A Legitimate Carrier Operator Has Degraded Service and Suspects Interference


Their Satellite Operator Uses Their Carrier Monitoring System to Observe the Legitimate Carrier
If an Interferer is Observed, Detection of its' Carrier ID is Attempted
If Carrier ID is Detected, the Satellite Operators Database is Used to Determine Its' Identity
If the Interferers Carrier ID Does Not Belong to a Carrier from the Satellite Operator, the Space Data Association is Consulted

How Will Carrier ID Be Used?
Step #2 – During Interference Events

Situation; A Satellite Operator Has Detected a Carrier ID From an Unknown Operator


The Space Data Association Determines the Satellite Operator and Carrier User Identity from Its' Database
The Space Data Association Contacts the Interferers Satellite Operator and Alerts Them to the Interference Issue
The Interferers Satellite Operator Contacts the Interferer to Resolve the Interference Issue

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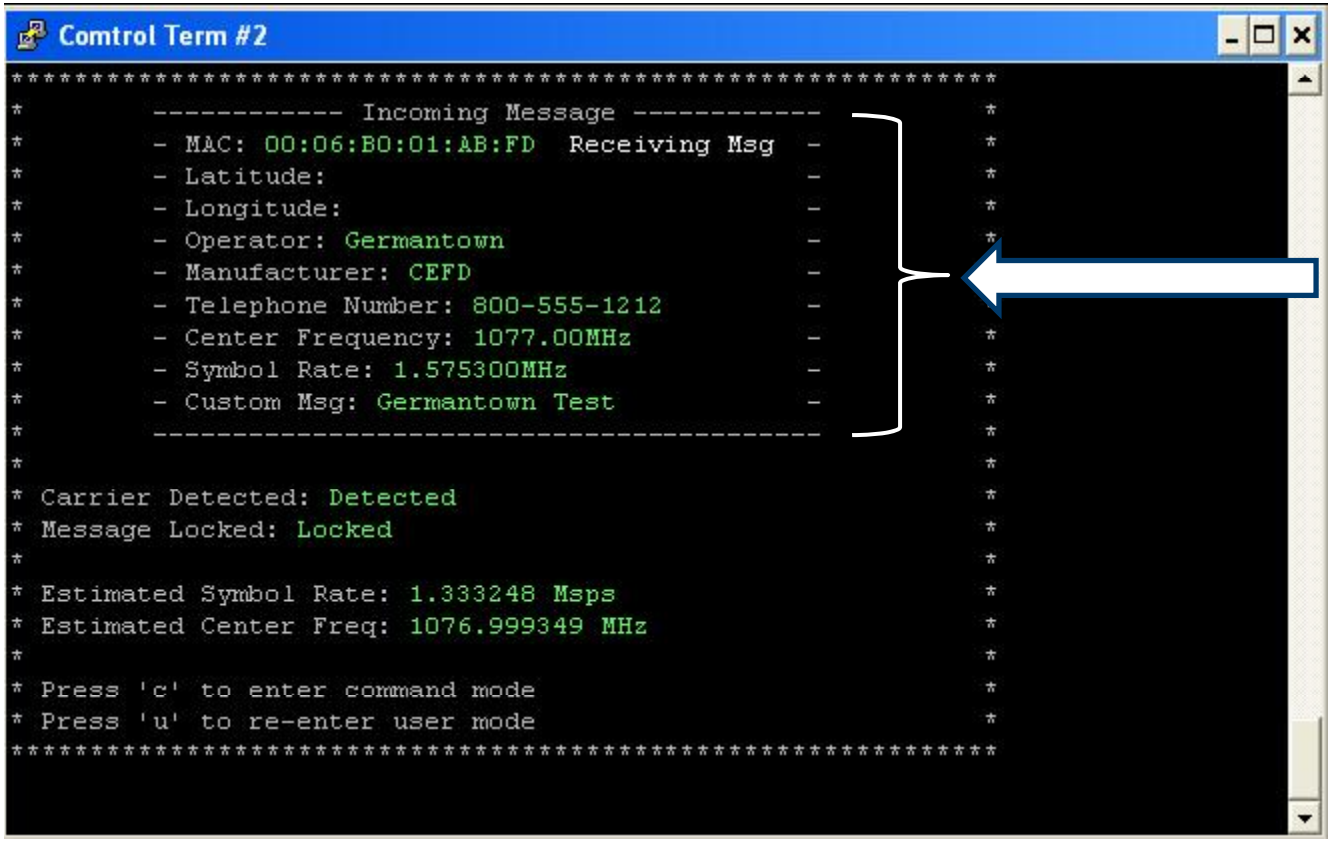
Carrier ID Products

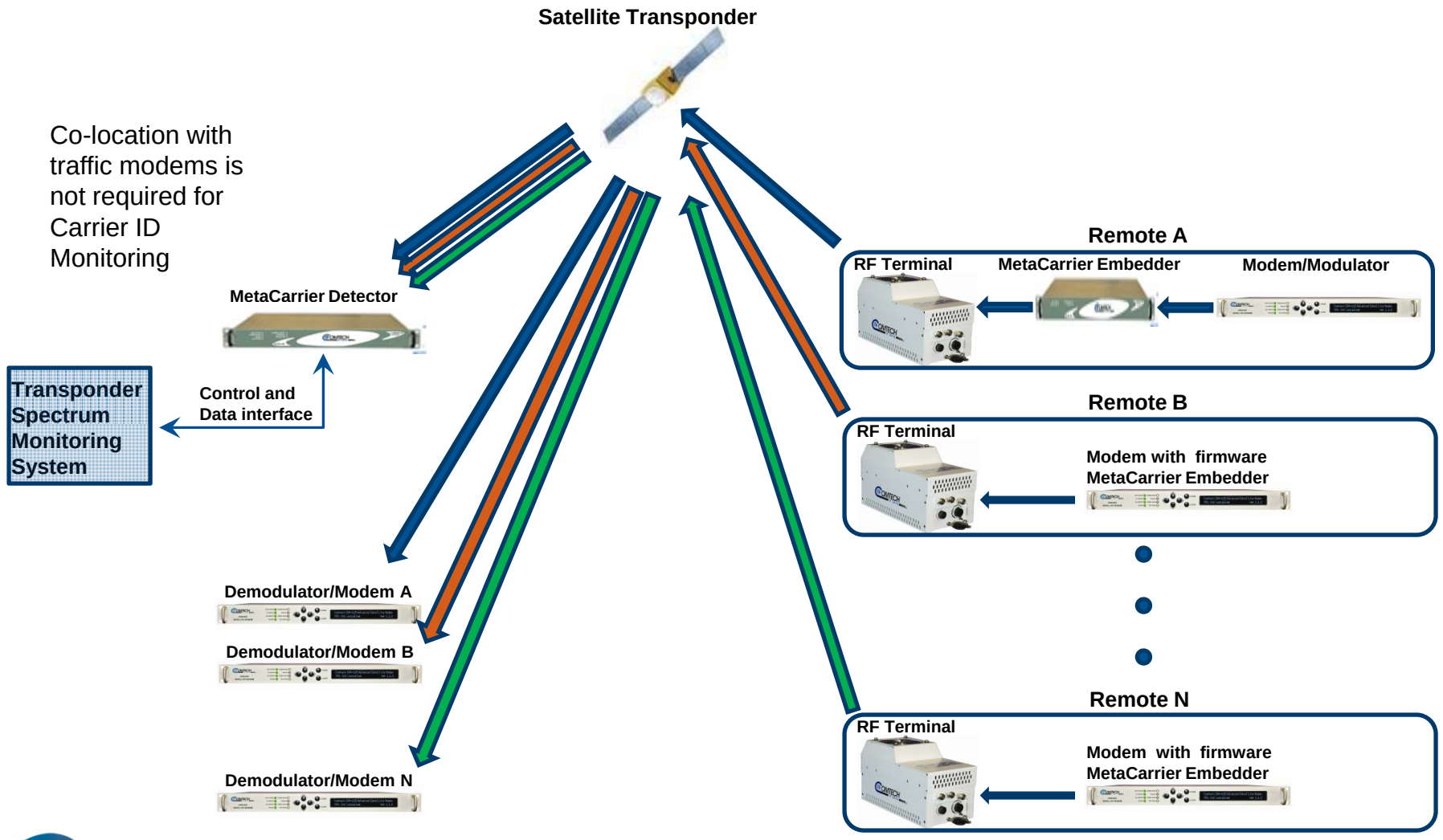
- Carrier ID Embedder; MetaCarrier Embedding Device (MCED)
  - Firmware or hardware version
  - For legacy equipment, can be an external device that is attached to the IF of the modulator or modem that is to be identified, or,
  - For newer equipment it can be firmware in the FPGA of the modulator or modem
  - The DVB version will work with all SCPC or video modulators from Comtech or other manufacturers
- Carrier ID Detector; MetaCarrier Detecting Device (MCDD)
  - Extracts the Carrier ID from the combined traffic and ID carrier
  - Used at a monitoring earth station

MCDD Decoded Carrier ID Format



This is the CEFD Carrier ID design; All of the fields for Carrier ID are optional and need not be transmitted.

CEFD Carrier ID Implementation Topology - SCPC



Minimal Impact of Implementation of MetaCarrier

Carrier ID Power Spectral Density Reduction Calculator

User Input

User Data Carrier Symbol Rate (9.6 Ksps to 63,000.0)	32.000	Ksps
User Data Carrier C/N Max (0.2 to 40.0)	20.0	dB
Noise Floor of System (-100.0 to 0.0)	-80.0	dB
Is Eb/No Information Known (Modulation and FEC Coding)?	Yes	
Modulation Index (1/2/3/4/5)	1	
FEC Code Rate	1.0	
User Input Required		

Carrier ID Configuration

Carrier ID Chip Rate	4,096	
CID Carrier Chip Rate	28.000	Kcps
CID C/N	0.1	dB
Scaling Ratio	87.50%	
Difference between Original Data Carrier and CID Carrier	19.9	dB
Spread Attenuation	-36.123599	dB
Spread Ratio	-0.579919	dB
Spread Correction	-36.703519	dB
Degraded C/N	19.90820175	dB

Degradation Output

Input C/N	20.0000	dB
Degradation due to CID	0.0918	dB
Output C/N	19.9082	dB
Output Eb/No	19.9082	dB

Carrier ID Awareness

Interfering
Signal:
Operators, Partners Take Industry Approach to Tackle Interference
DECEMBER 2011 VIA SATELLITE MAGAZINE WWW.SATELLITETODAY.COM

Comtech EF Data Wins Industry Innovators Award for MetaCarrier Technology

Addresses Satellite Industry's Radio Frequency Interference Challenge

TEMPE, Arizona, February 15, 2012 – Comtech EF Data Corporation announced today that its MetaCarrier™ technology won the Industry Innovators Award by the Society of Satellite Professionals International (SSPI). The MetaCarrier technology embeds and detects Carrier ID on video and data satellite carriers, and significantly reduces the time to identify and clear satellite transponders of interference sources.

eutelsat COMMUNICATIONS

EUTELSAT LAUNCHES QUALITY ASSURANCE INITIATIVE FOR DVB SATELLITE TRANSMISSIONS

New development spearheaded with broadcasters and satellite industry groups to safeguard the quality of satellite services

Through this new initiative, Carrier Identification will be integrated into transmission parameters for all SNG transmissions and new DVB broadcasts from 30 June 2012. Simple firmware enhancements to existing operational uplink equipment have already been developed by key manufacturers. Carrier Identification will enable Eutelsat to more efficiently identify transmissions to its satellites and accelerate coordination with earth station operators.

Intelsat's Interference Management Initiative (I^3)

I^3 Industry Initiatives – Improving Quality of Service Across the Industry

As part of the I^3 industry-wide activities, Intelsat is working with satellite operators, industry groups, customers and equipment manufacturers to make RFI reduction a top priority.

Carrier ID

Carrier ID is the transmission of uplink GPS location data, along with other important information such as originator and equipment details. This information is embedded in the modem transmit header as part of the current encoder METADATA standards. However, for Carrier ID to be a successful tool in the battle against RFI, equipment vendors and manufacturers must implement the technology as a standard feature by including this requirement within their equipment purchase specifications.

Intelsat and other satellite operators, in conjunction with the Satellite User Interference Reduction Group (SUIRG), are working with hardware manufacturers to ensure that the technology embedded accurately detects, analyzes and locates incidents of RFI. This will allow satellite operators to communicate directly with the RFI source to resolve the incident.

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AsiaSat

中信卫星通讯

CITIC Networks Co.,Ltd.Satellite Telecommunications Branch 2011年07月·总第11期

中国中信集团公司 CITIC Group

技术园地

MetaCarrier技术在载波身份识别中的应用

长期以来，卫星上的载波干扰问题，一直困扰着卫星转发器运营商们，他们不惜投入大

这来，但是始终无法有效解决这个问题。

Carrier ID Progress

- Technology has been demonstrated and tested, and has performed as advertised
  - Started December 2010
  - Intelsat, SES, Turner, CBS (one month on-air, national distribution)
- Longer term operation underway during and after this Summer Olympics
  - Embedders installed on Intelsat North America, SES Europe and Eutelsat Carrier ID test carriers
- Detectors for the Carrier IDs are installed at Carrier Monitoring System manufacturers for the development of their specific monitor and control interfaces
  - Crystal Solutions
  - Sat Corp (Monics)
  - Siemens AG

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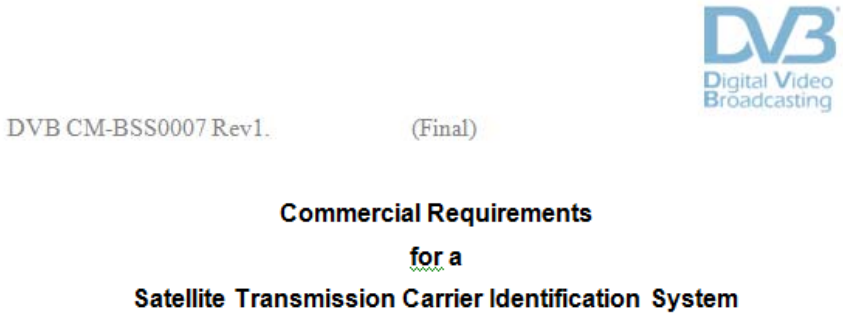
DVB and Carrier ID


DVB CM-BSS0007 Rev1. (Final)

Commercial Requirements

for a

Satellite Transmission Carrier Identification System

- With the backing of satellite operators and equipment manufacturers the DVB has undertaken the process to standardize Carrier ID
- The commercial requirements were adapted by the DVB Commercial Module on Feb 15 of this year
- The Technical Module is underway and close to finishing
- Adaptation is possible by the end of CY 2012

Questions / Comments ?

Thank You

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